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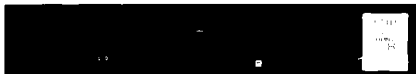
SECOND INTERIM REPORT ON CONTRACT DAJA45-87-C-0010 FOR  
THE IMPERIAL COLLE. (U) IMPERIAL COLL OF SCIENCE AND  
TECHNOLOGY LONDON (ENGLAND) DEPT.. F B CARLTON ET AL.  
31 DEC 87 DAJA45-87-C-0010

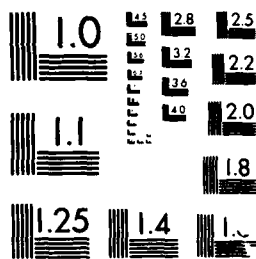
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DEPARTMENT OF CHEMICAL ENGINEERING AND CHEMICAL  
TECHNOLOGY

IMPERIAL COLLEGE

U.S. ARMY CONTRACT NO. DAJA 45-87-C-0010

2ND INTERIM REPORT

31st July 1987 - 31st December 1987

F.B. Carleton  
K. Krallis  
F.J. Weinberg

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### Introduction

The contract is now fully staffed but progress has still been held up by the non-availability of a suitable laser and our attempts to bring our ancient device into a working condition. In parallel with these attempts, work on electrical initiation has been started.

### Staffing

Mr. Konstantinos Krallis has been appointed to the student vacancy as from October 1st, 1987. Mr. Krallis has just completed a highly successful Master's project which involved the development of a pulsed power supply for plasma jets used in gas turbine ignition work. Although his first degree is in Chemical Engineering, this research background made him particularly well-suited to the project in hand. He is registered for an M.Phil. degree in the first instance and is expected to proceed to a Ph.D. of London University by thesis.

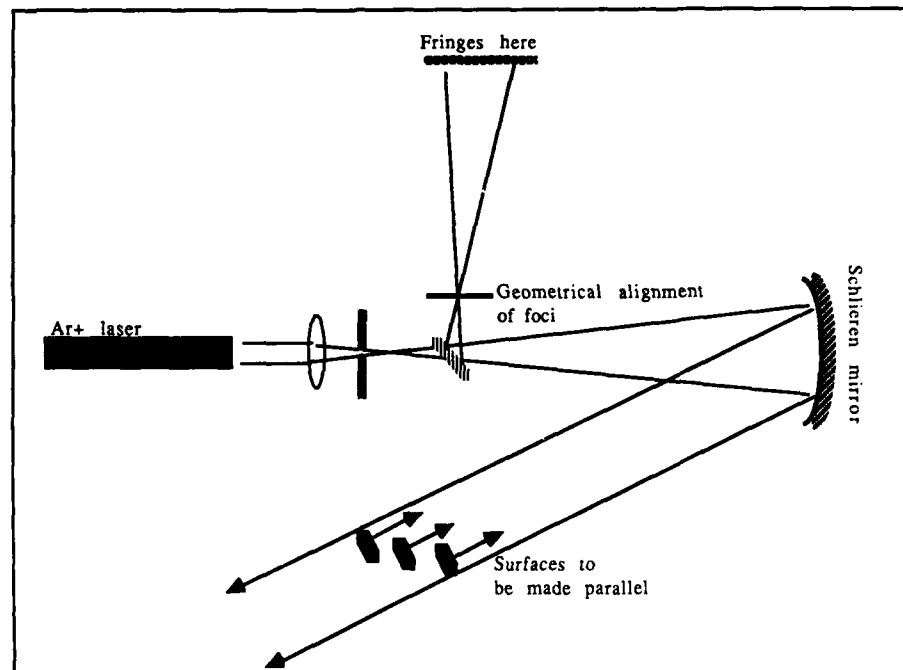
### Initiating Laser

At the time of writing this report, we still do not have a working Q-switched laser. It is hoped that this situation will resolve itself in the near future, as the result of two separate approaches:

The first is that Dr. Nathan Klein, during a recent visit, informed us that a BRL 5J laser is currently being upgraded and should be available on loan to us in the near future. Although we would have felt more comfortable with a larger margin of energy, results of the previous contract suggest that 5J ought to be sufficient, provided reflections and other losses are not substantial.

As regards our defunct 211A pulsed ruby laser, further work in collaboration with Dr. Klein, led to the suggestion that the various optical components have not been aligned to a sufficient degree of accuracy. Accordingly, an entirely new and highly sensitive collimating system was developed, based on our Schlieren mirror. This is illustrated in Figure 1.

It uses the very large optical lever given by the 8 ft. focal length of the mirror



**Figure 1.** Collimator based on Schlieren mirror.

for geometrical alignment in a first stage, followed by using fringe systems as the criterion for parallelity in a highly sensitive second stage.

The *modus operandi* should be clear from Fig. 1. A semi-reflecting glass slab at  $45^\circ$  to the optic axis turns the system into an "auto collimator". By lining up the focal spots after reflection to within 0.5 mm, parallelism to within about  $2 \times 10^{-4}$  rads can be attained. Fine adjustment of the focal spot position can be achieved by using the optical thread screws at the back of the Schlieren mirror. Once alignment has been optimised by such "geometrical" means, the screen in the focal plane is removed and fringes are viewed in the overlapping light cones further down beam. Fine adjustment is then achieved by using the criterion of increasing their spread and minimising the number of fringes across the field of view. Preliminary work with the device suggests that the degree of silvering and parallelism of the faces of the beam splitter is an important factor in avoiding stray fringe systems in the field of view.

This work has been temporarily suspended because an opportunity has arisen for obtaining external help from an expert in ancient lasers. He is currently testing our device.

### Electrical System

It has always been part of the objective of this work to combine electrical with laser initiation. As mentioned in the conclusions to the preceding research project, precursory electrolysis may profoundly affect ignition by any source, if solution in the propellant of gases liberated at the electrodes play a significant part in the process. Accordingly, it was decided to use the means of suspending propellant droplets in the beam simultaneously for the electrical initiation. A second wire loop has been added to the system which was proposed for suspending the droplets (see First Interim Report) and the two loops have been connected to the electrical power supply used in the previous phase of our research. The system is illustrated in Figure 2 with the proposed locations of the initiating and diagnostic laser beams shown dotted. Precise positioning of the loops is controlled

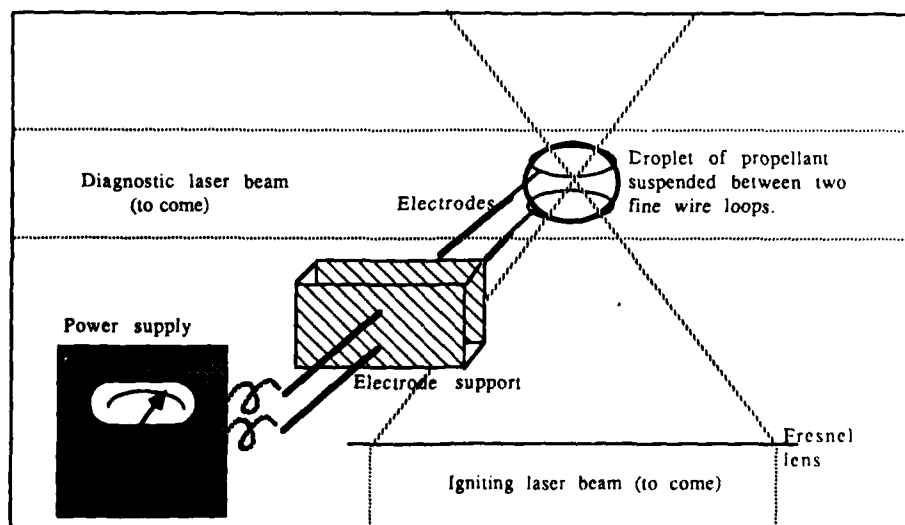


Figure 2.

Droplet initiation by discharge

page 1

by clamping in the retaining support, as shown in the Figure. Heavier gauge wire is used for the leads to the fine wire loops which have to be re-positioned after each experiment since they are distorted by the explosion.

Preliminary experiments on exploding droplets of propellants in this manner show similar dependence on electrical parameters as in our previous work. There is a voltage threshold above which the event becomes very vigorous. When large droplets are used not all the liquid is decomposed and small satellite droplets are seen to be flung off.

Work is in progress comparing the behaviour of propellants in this system with aqueous solutions of salts which have similar electrical properties but are not capable of decomposing chemically. In the next phase of the work also the event is to be followed photographically, using the high speed optical system.

Two short focal length Fresnel lenses procured from the Edmund Scientific Corporation by Dr. Klein will also be tested and installed in the next phase of the work; pending availability of the Q-switched laser, other light sources will be used for this purpose.

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